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# PROGRESS REPORT

# FOR

# APRIL 1955

# ON

# 4-INCH ROCKET

3 June 1955

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Work during the month of April was confined primarily to the fabrication and field testing of units designed to travel to the longest range.

The first series of tests consisted of three units, each supplied with six eight-inch grains. Two of the units had nozzle throat diameters of 0.437" while the third unit had a throat diameter of 0.543". The three units varied in weight from 4 lb. 4 oz. to 4 lb. 7-1/2 oz. All motor tubes were of the thin wall variety having an inside diameter of 3/4" and an outside diameter of 7/8". The head and cap of each unit were held together by six 1/4" bolts, using a rubber O-ring for the pressure seal. The total length of each unit was 18-1/4". The total weight of propellant powder used in each unit was 282 grams.

When each unit was fired, the same type of failure occurred in each case. All six bolts in each of the three units broke at a point near the juncture of the threads and the shank of the bolt.

It was generally agreed that six bolts of the type employed were not sufficient to withstand the increased setback force of the longer range models. This would indicate a requirement for either more bolts of the same size or larger bolts.

In the next series of tests, which consisted of three units, several design changes were made. The number of individual motor tubes was reduced from 6 to 5 in order to provide more reinforced head plate material between each tube. Nozzles with larger throat diameters (0.468") were used in order to reduce the $K_n$ value and resultant pressure. Larger motor tubes were obtained and employed in these units, each having an inside diameter of 7/8" and an outside diameter of 1". One unit employed 5 powder grains of 6-3/4" length with a total weight of 198 grams, and a 0.468 nozzle throat diameter, giving a $K_n$ value of 110. When fired, this unit chuffed out.

The second unit employed five 8" grains of powder with a total weight of 235 grams. This unit also had a nozzle throat diameter of 0.468", giving a $K_n$ value of 129. When fired, this unit took off satisfactorily, but during flight, it appeared that one of the motor tubes blew out. Probable cause of this failure was due to poor bonding of the tube to the head plate.

The third unit fired employed five 8" grains weighing 235 grams. This unit had nozzle throat diameters of 0.453" giving a $K_n$ value of 138. When fired, this unit lost one nozzle. During flight it seemed stable, but of course, did not reach the calculated range.

The next series of units prepared for test firing was prepared in approximately the same manner as the previous series with special attention given to an increase in the $K_n$ value to a point where chuff-out was less likely to occur. The first unit employed five motor tubes with powder grains having a total weight of 176 grams. The throat diameter of the nozzles was 0.422", giving a $K_n$ value of 120. When fired, this unit chuffed out but landed intact, 117 yards away. This test indicated that a $K_n$ value of 120 is still too low to eliminate chuffing.

The second unit employing five motor tubes and powder grains with a total weight of 217 grams, had a throat diameter of 0.468" with a $K_n$ value of 120. When fired, this unit flew satisfactorily, although one chuff was noted during flight. This unit traveled approximately 2500 feet.

The third unit employed five motor tubes with five powder grains weighing a total of 225 grams. The nozzles had a throat diameter of 0.468" and a $K_n$ value of 125. When fired, all tubes were blown out including the star portion of the head-plate. This failure indicated a structural weakness in the head-plate portion of the motor.

The next series of units tested were fabricated with special attention being given to bonding of the tubes into the head. The $K_n$ value of each unit was raised to 135. Each unit employed nozzles with a throat diameter of 0.468" and a total powder weight of 235 grams. When the first unit was fired, it took off normally and was observed to fly very stably from the launching site until it traveled out of sight. One observer, located at a distance of one mile from the launching site, reported hearing it travel overhead but never caught sight of the missile. The estimated range of this unit was approximately 2,000 yards, although it was not recovered. When the second rocket was fired, considerable chuffing was noted during flight and upon recovery, some 125 yards away, it was noted that three nozzles had been blown out. The third unit, made up in the same manner as the previous tube was fired and took off in a normal manner and flew for approximately 3500 feet. When recovered, it was noted that one tube was missing indicating that either the tube or nozzle was blown out. The tube with nozzle was not recovered.

It can be concluded, from the several series of tests fired during the month of April, that some changes in design are required in order to prevent structural failure. The great majority of failures can be traced to either nozzles or tubes being blown out. Further static testing will establish the most satisfactory $K_n$ level in order to prevent either chuffing out or excessive head pressure.

## Future Work

Efforts will be made to revise the design of the long range models to a point where either success or failure of the units will not depend entirely upon good bonding of the tubes and nozzles.

## Financial Status

50X1

Total Amount of Contract (Phase I)

Expenditures During April 1955

Total Expenditures to April 30, 1955

Total Unexpended Balance

Expiration Date - 1 May 1955





logged 4/30/55